

SPECIES OF *RAILLIETINA* FUHRMANN, 1920 (CESTODA: DAVAINIIDAE) FROM THE EMU, *DROMAIUS NOVAEHOLLANDIAE*

by MICHAEL G. O'CALLAGHAN*, MARGARET DAVIES† & ROSS H. ANDREWS†

Summary

O'CALLAGHAN, M. G., DAVIES, M. & ANDREWS, R. H. (2000). Species of *Railletina* Fuhrmann, 1920 (Cestoda: Davainiidae) from the emu, *Dromaius novaehollandiae*. *Trans. R. Soc. S. Aust.* **124**(2), 105–116, 30 November, 2000.

Four new species of *Railletina* Fuhrmann, 1920 (Cestoda: Davainiidae) are described from the intestine of the emu, *Dromaius novaehollandiae*. *Railletina australis* (Krabbe, 1869) Fuhrmann 1924 is redescribed from specimens collected in Australia. The new species differ from *R. australis* and from each other, in the size and number of rostellar hooks and in the dimensions of the cirrus sac.

KEY WORDS: Cestoda, emu, *Railletina*, new species, *Dromaius novaehollandiae*.

Introduction

The emu, *Dromaius novaehollandiae* (Latham, 1790), is one of only two ratites (Struthioniformes: Dromatidae) inhabiting Australia. Restricted to mainland Australia, emus are now farmed for meat, oil, leather and eggs. In 1995 there were 650 licensed emu farms in Australia with a population of 71,000 emus producing 78,000 chicks annually (Mannion *et al.* 1995). Recently Clarke *et al.* (1996), Tully & Shane (1996) and Shane (1998) reviewed the infectious and parasitic diseases of farmed emus although they did not include any information on cestode parasites.

Cestodes were first recorded in emus in 1869 when Krabbe published a description of *Taenia australis* (Davainiidae) recovered from the intestine of a captive emu which had died in the Copenhagen (Kjærbøelling's) Zoological Garden in 1867. The emu had arrived from Australia 1.5 years earlier as a fully-grown bird (Krabbe 1869).

Later, Fuhrmann (1909) described another davainiid species, *Cotugnia collini*, from an emu in the Museum für Natural Sciences in Berlin. The exact locality for this specimen is not known because the geographic distribution of the host is reported as eastern Australia. No subsequent records of cestodes in the emu exist and the identity of the cestodes infecting these birds in Australia is unknown. Both of the described parasites of emus are recognised as valid species (Schmidt 1986) although Krabbe's (1869) description of what is now *Railletina*

australis lacks a number of morphometric and descriptive characters.

Our study of farmed and wild emus has resulted in the recognition of five species of cestode. All are assigned to *Railletina* Fuhrmann, 1920 (*sensu* Jones & Bray 1994) on the basis of the possession of two rows of numerous hammer-shaped hooks, uni-lateral genital pores, a small cirrus sac, which does not reach or just crosses the osmoregulatory canals and egg capsules containing several eggs. One species is identified as *Railletina australis* whilst the other four are undescribed. Here we redescribe *R. australis* from the holotype and new material and describe the new species.

Materials and Methods

Cestodes were collected from farmed and wild emus in South Australia. Additional material was obtained from the Australian Helminthological Collection of the South Australian Museum (AHC). Cestodes were relaxed in tap water, fixed in 10% buffered formalin and stored in 70% ethanol. Whole mounts were stained with Heidenhain's haematoxylin, Celestine blue or Semichon's acetocarmine, dehydrated in a graded series of ethanol, cleared in clove oil and mounted in Canada balsam. Scoleces were mounted in DeFaure's medium. Measurements are given in the text, in mm, as the range followed, in parentheses, by the mean and the number of observations. Descriptions and measurements of cestodes are based on the examination of up to 50 specimens of each species. Drawings were made with the aid of a camera lucida attached to an Olympus BH microscope. Type specimens have been deposited in the Australian Helminth Collection (AHC), South Australian

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Museum, Adelaide (SAMA) and the British Museum (Natural History), London (BMNH).

Ruilhetina australis (Krabbe, 1869) Fuhrmann, 1924 (FIGS 1-7)

Taenia australis Krabbe, 1869. K. Danske Vidensk Selsk. Skr. Naturv. Og Math. Afd. 8, 249-363. Figs 296-298.

Davainea australis (Krabbe, 1869) Blanchard, 1891

Ransomia australis (Krabbe, 1869) Fuhrmann, 1920

Kotlania australis (Krabbe, 1869) Lopez-Neyra, 1931

Holotype: In Zoologisk Museum, Copenhagen, Denmark.

Paratypes: Kadina, South Australia (SA) (33° 58' S, 137° 48' E). Coll. M. O'Callaghan, 11.vii.1995, SAMA AHC 31376, BMNH 2000.5.17.1-10.

Other material examined: Werribee, Victoria (Vic.), Coll. K. E. Harrigan, April 1988, SAMA AHC 18391; Shelley River, Queensland, 29.ix.1907, SAMA AHC 227; Kinchega, New South Wales (NSW), Coll. J. Beyeridge, 31.iii.1974, SAMA AHC 10006; Yunta, SA, Coll. G. E. Ford, 1.ix.1981, SAMA AHC 11181; North West, Western Australia, Coll. T. H. Johnston, SAMA AHC S20431.

Description

Cestodes of moderate size, up to 50 in unrelaxed specimens and up to 110 in relaxed specimens. Maximum width 1.2. Strobila containing approximately 1150 proglottides. Scolex 0.416-0.568 (0.498, n=20) in diameter with eversible rostellum (Figs 1, 2), rarely everted in fixed specimens. Rostellum 0.200-0.288 (0.249, n=10) in diameter armed with 280-362 (326) hammer-shaped hooks arranged in two rows. Larger rostellar hooks 0.021-0.030 (0.025, n=250) in length, smaller rostellar hooks 0.016-0.023 (0.020, n=250) (Fig. 3). Base of rostellum armed with 16-20 rows small, rose-thorn-shaped accessory spines 0.002-0.004 in length. Suckers 0.136-0.168 (0.149, n=30) in diameter armed with eight diagonally arranged rows of hooks 0.005-0.011 in length (Fig. 4).

Proglottides craspedote. Mature proglottides wider than long, 0.160-0.184 (0.171) x 0.800-0.848 (0.822, n=10) (Fig. 5). Genital pores single, unilateral, 0.016 in diameter; genital ducts passing between longitudinal osmoregulatory canals. Dorsal osmoregulatory canal 0.048 in maximum diameter, lying internal to smaller ventral osmoregulatory canal, 0.020 in diameter. Transverse osmoregulatory

canals connecting left and right ventral canals at posterior margin of each proglottis.

Genital atrium small, situated in anterior half of lateral proglottis margin and surrounded by an accumulation of cells. Cirrus sac elongate 0.152-0.164 (0.158) x 0.016-0.024 (0.020, n=10) (Fig. 6) extending to but not beyond dorsal osmoregulatory canal. Distal region of cirrus of greater internal diameter than mid region, armature not seen; proximal region forming small, spherical, internal seminal vesicle, 0.016 in diameter. Cirrus sac in holotype specimen 0.149 x 0.023, also with internal seminal vesicle 0.016 in diameter. Coiled vas deferens passing towards centre of proglottis where it becomes convoluted, occasionally overlying seminal receptacle before passing posteriorly towards ovary. Testes in poral and aporal fields, number 4-7 (5) poral and 11-13 (11, n=10) aporal, bounded by lateral osmoregulatory canal. Testes 0.044-0.052 (0.048, n=10) in diameter.

Vagina opening to genital atrium posterior to cirrus sac (Fig. 7). Distal region slightly enlarged 0.024-0.032 (0.029) x 0.010-0.016 (0.015, n=10). Mid region, narrow, coiled 0.005 in diameter, leading to seminal receptacle medially posterior to vas deferens, 0.084-0.128 (0.122) x 0.024-0.032 (0.026, n=10) and lying anterior and dorsal to poral lobe of ovary. Ovary distinctly bilobed, situated in mid line of proglottis. Poral lobe 0.040-0.072 (0.049) x 0.040-0.060 (0.048, n=10), aporal lobe 0.044-0.072 (0.060) x 0.032-0.072 (0.043, n=10) with 3-5 lobules in each lobe. Vitellarium irregularly lobulate, post ovarian, slightly aporal, occasionally dorsal to aporal lobe of ovary, 0.060-0.080 (0.068) x 0.036-0.048 (0.042, n=10). Uterine duct passing anteriorly to developing uterus. Gravid proglottides extending transversely 0.720 x 0.350 with large osmoregulatory canal up to 0.120 in diameter. Egg capsules irregularly ovoid 0.108-0.132 x 0.08-0.104. Egg capsules 76-110 (88, n=10) per gravid proglottis containing 10-14 (11, n=40) eggs. Terminal proglottides extending transversely, as wide as long 0.580-0.800 x 0.600-0.880. Oncosphere 0.012 in diameter, oncospherical hooks 0.005-0.007 long.

Host

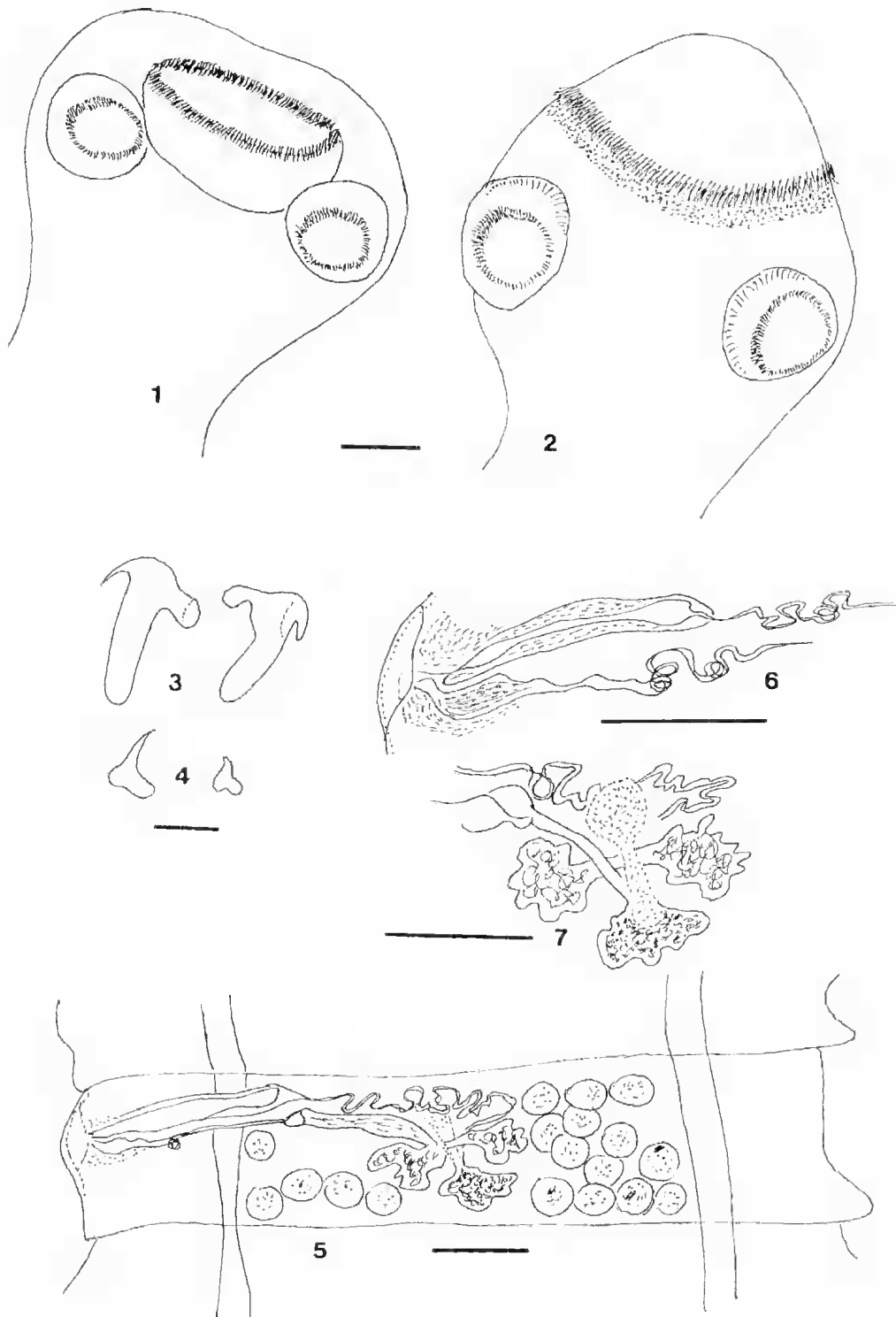
Dromaius novae-hollandiae (Latham, 1790) (Struthioniformes, Dromaiidae).

Location in host

Small intestine.

Remarks

Krabbe (1869) omitted the dimensions of the scolex, rostellum and suckers in his description of *R. australis* and the strobila was inadequately



Figs 1-7. *Raillietina australis* Krabbe. 1. Scolex with retracted rostellum. 2. Scolex with fully everted rostellum. 3. Rostellar hooks 4. Sucker hooks. 5. Single mature proglottis. 6. Cirrus and distal vagina. 7. Female genitalia. Scale bars = 0.1 mm, 1, 2, 5-7; 0.01 mm, 3, 4.

described. The material described above, based on the examination of 50 cestodes, indicates that Krabbe's (1869) measurements of the postellar hooks (12-14 mm) are consistent with hook width but not hook length although this cannot be confirmed because of the absence of a scolex in the type material examined. The fragments of type material obtained, however, do not differ from specimens examined in this study and have thus enabled the redescription of *R. australis*:

Railletina beveridgei sp. nov.
(Figs 8-14)

Holotype: Keith, SA (36° 06' S, 140° 19' E), Coll. M. O'Callaghan, 30.iii.1999, SAMA AHC S28300.

Paratypes: Lock, SA (33° 34' S, 135° 45' E), Coll. M. O'Callaghan, 9.iii.1996, SAMA AHC S28301, 31377, BMNH 2000.5.17.11-30.

Other material examined: Yunta, SA, Coll. G. E. Ford, 1.ix.1981, SAMA AHC 11181, S21347; Werribee, Vic., Coll. I. Beveridge, 23.vi.1995, SAMA AHC 26698; Mundulla, SA, Coll. Dinning, February 1933, SAMA AHC 1187; Bairnsdale, Vic., Coll. I. Beveridge, 5.xii.1994, SAMA AHC S27717, S27718; Condobolin, NSW, Coll. Ryan, 27.i.1971, SAMA AHC 9179; Vic., Coll. D. Turner, 1994, SAMA AHC S26205; NSW, Coll. T. H. Johnston/T. L. Baneroff, 1914, SAMA AHC S20430, S 20433; La Trobe, Vic., Coll. I. Beveridge, 24.vi.1972, SAMA AHC S20837; Bairnsdale, Vic. Coll. I. Beveridge, Scolex only, 5.vii.1994, SAMA AHC S27717, S27718; Vic., 1994, SAMA AHC S26205.

Description

Large cestode, up to 160 long in unrelaxed specimens and up to 600 in relaxed specimens; gravid strobila containing approximately 750 segments. Strobila with max. width 3.8 in relaxed specimens. Scolex 0.480-0.736 (0.609, n=25) wide at suckers (Fig. 8). Retracted rostellum 0.192-0.258 (0.234, n=10) diam. with 304-412 (370, n=10) hammer-shaped hooks in two rows. Larger rostellar hooks 0.016-0.021 (0.019, n=250) long; smaller rostellar hooks 0.014-0.019 (0.016, n=250) long (Fig. 9). Very small accessory rostellar spines approximately 0.001-0.002 in length only visible under high magnification. Suckers circular 0.136-0.168 (0.150, n=10) in diameter armed with 12-18 rows hooklets 0.004-0.011 long (Fig. 10). Neck variable, up to 0.250 in length. Calcareous corpuscles present in posterior half of scolex.

Proglottides craspedote. Mature proglottides wider than long, 1.554-1.932 (1.730) x 0.273-0.399 (0.326, n=20) (Fig. 11). Genital pores single, unilateral.

Large, ventral, longitudinal osmoregulatory canal 0.108 max. diam. joined by transverse canal connecting left and right lateral canals in posterior margin of each proglottis. Dorsal canals not seen. Genital anlage appear in approximately segment 150. Male and female genitalia mature in proglottides 200 and 300 respectively; first eggs appear in 480.

Genital atrium small, situated in anterior half of lateral proglottis margin. Cirrus sac 0.256-0.328 (0.298, n=10) x 0.080 extending to ventral osmoregulatory canal (Fig. 12). Distal region of cirrus lined with spines, of greater internal diameter than sinuous mid region; proximal region forms spherical internal seminal vesicle 0.060-0.092 (0.079) x 0.052-0.060 (0.056, n=10), not detectable in proglottides of every cestode examined. Vas deferens greatly coiled, extending anteriorly across midline of each proglottis then returning posteriorly towards ovary. Testes distributed in poral and aporal fields within area defined by ventral osmoregulatory canals, number 5-9 (7, n=30) poral and 12-18 (15, n=30) aporal. Testes sub-circular: 0.080-0.100 (0.088) x 0.080-0.088 (0.083, n=10) not overlying ovary or vitellarium.

Vagina opening to genital atrium posterior to cirrus sac. Distal region with thickened muscular wall 0.088-0.120 (0.106, n=10). Mid region of vagina narrow, coiled, leading medially, posterior to vas deferens to seminal receptacle varying in length from 0.088-0.240 (0.100, n=20) in length, lying anterior to testes and poral lobe of ovary. Sperm duct passing posteriorly from seminal receptacle. Ovary bilobed, 0.084-0.132 (0.110) x 0.080-0.088 (0.082, n=10) with 4-6 lobules in each lobe (Fig. 13). Vitellarium ovoid, 0.112-0.136 (0.120) x 0.080-0.100 (0.087, n=10) situated posterior to ovary; uterine duct passing anteriorly to developing uterus. Gravid proglottides wider than long, 2.5-2.7 x 0.4-0.5. Terminal proglottides longer than wide, 1.0 x 0.9 (Fig. 14). Gravid proglottides containing 30-40 (35, n=10) egg capsules, 0.168-0.200 (0.184) x 0.144-0.196 (0.161), n=10) each containing 10-12 eggs, 0.040 in diameter. Oncosphere 0.014-0.016 (0.016) x 0.011-0.016 (0.013, n=10). Oncospheral hooks 0.004-0.006 (0.005, n=10).

Host

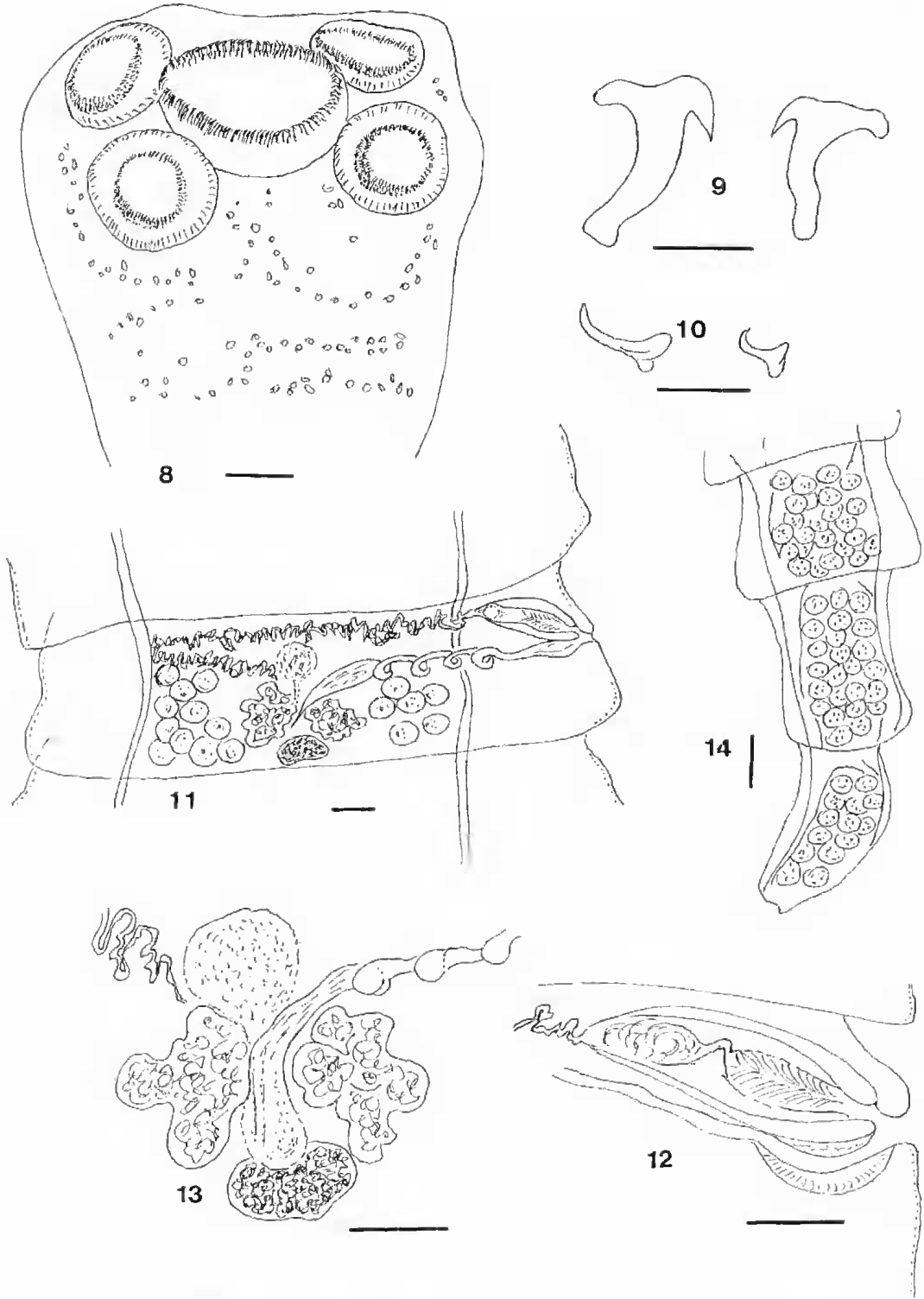
Dromaius novaehollandiae (Latham, 1790) (Struthioniformes: Dromaidae).

Location in host

Small intestine.

Etymology

This species named for Dr I. Beveridge in recognition of his outstanding contribution to our



Figs 8-14. *Raillietina beveridgei* sp. nov. 8. Scolex. 9. Rostellar hooks. 10. Sucker hooks. 11. Single mature proglottis. 12. Cirrus and distal vagina. 13. Female genitalia. 14. Terminal gravid proglottides. Scale bars = 0.1 mm, 8, 11-14; 0.01 mm, 9, 10.

knowledge of the parasites of the Australian endemic fauna and his guidance to the senior author.

Raillietina chiltoni sp. nov.
(FIGS 15-22)

Holotype: Keith, SA (36° 06'S, 140° 19'E), SAMA AHC S28302.

Paratypes: Kersbrook, SA (34° 47'S, 138° 51'E), Coll. I. Beveridge, I.iv.1989, SAMA AHC 31378, BMNH 2000.5.17.31-40.

Description

Cestodes up to 90 in relaxed specimens, maximum width 1.4. Strobila contain approximately 360 proglottides. Scolex 0.545-0.832 (0.643, n=20) in diameter with eversible rostellum, 0.336-0.480 (0.383, n=10) in diameter, retracted in majority of specimens (Figs 15, 16). Rostellum armed with 302-378 (335, n=10) hammer-shaped hooks in two rows. Larger rostellar hooks 0.026-0.039 (0.032, n=250) in length; smaller rostellar hooks, 0.022-0.034 (0.027, n=250) in length (Fig. 17). Base of rostellum armed with rose-thorn-shaped accessory spines, 0.003 in length, visible under high magnification only and in specimens with fully everted rostellum. Suckers 0.136-0.200 (0.171, n=30) in diameter, armed with 8-14 rows of hooks 0.005-0.013 long (Fig. 18). Neck variable in length, 0.4-0.8 in relaxed specimens.

Proglottides craspedote. Mature proglottides 0.890-1.400 x 0.072-0.1400 (Fig. 19). Genital pores single, unilateral; genital ducts passing between osmoregulatory canals. Dorsal osmoregulatory canal extremely narrow, diam. 0.002, lying internal to ventral osmoregulatory canal, 0.012 max. diam. Transverse osmoregulatory canals connecting right and left ventral canals at posterior margin of each proglottis. Dorsal commissures not seen. Genital anlage appearing in proglottis 40 approximately; first mature proglottis 160; first gravid proglottis 280.

Genital atrium small, situated in anterior half of lateral proglottis margin. Cirrus sac 0.104-0.112 (0.108) x 0.036-0.040 (0.038, n=10), not reaching longitudinal osmoregulatory canals (Fig. 20). Cirrus un-armed, distal region of greater internal diameter than mid region; leading uncoiled to internal seminal vesicle 0.015 (0.012-0.016) x 0.012 (0.012-0.014). Vas deferens greatly coiled, passing towards centre of proglottis. Testes distributed in two lateral groups, 3-5 (4, n=20) poral and 7-11 (9, n=20) aporal. Testes 0.056-0.068 (0.062, n=20) in diameter; not overlying female genital organs.

Vagina opening to genital atrium posterior to cirrus sac; distal region surrounded by cells, 0.032-0.036 (0.035) x 0.012-0.020 (0.015, n=10). Mid region coiled, often dilated with sperm, leading medially

posterior to vas deferens, greatly dilated and saecular anterior to poral lobe of ovary (Fig. 21). Ovary bilobed, situated in proglottis midline, enlarging in consecutive mature proglottides, maximum size 0.220 x 0.080 in posterior mature proglottides. Vitellarium similarly enlarging, maximum dimensions 0.184 x 0.080, situated posterior and distal to aporal lobe of ovary. Sperm duct passing posteriorly between lobes of ovary, uterine duct passing anteriorly to developing uterus. Gravid proglottides 1.200-1.700 x 0.200-0.440 (Fig. 22) containing 32-50 (38, n=10) spherical egg capsules, 0.136-0.184 x 0.136-0.192, with 14-17 (15, n=10) eggs per capsule. Oncosphere circular, 0.016-0.020 in diameter, oncospherical hooks 0.006-0.008.

Host

Dromaius novaehollandiae (Latham, 1790) (Struthioniformes: Dromaidae).

Location in host

Small intestine.

Etymology

This species is named for Dr N. Chilton of the University of Melbourne for his contribution to parasitology in Australia.

Raillietina dromaius sp. nov.
(FIGS 23-30)

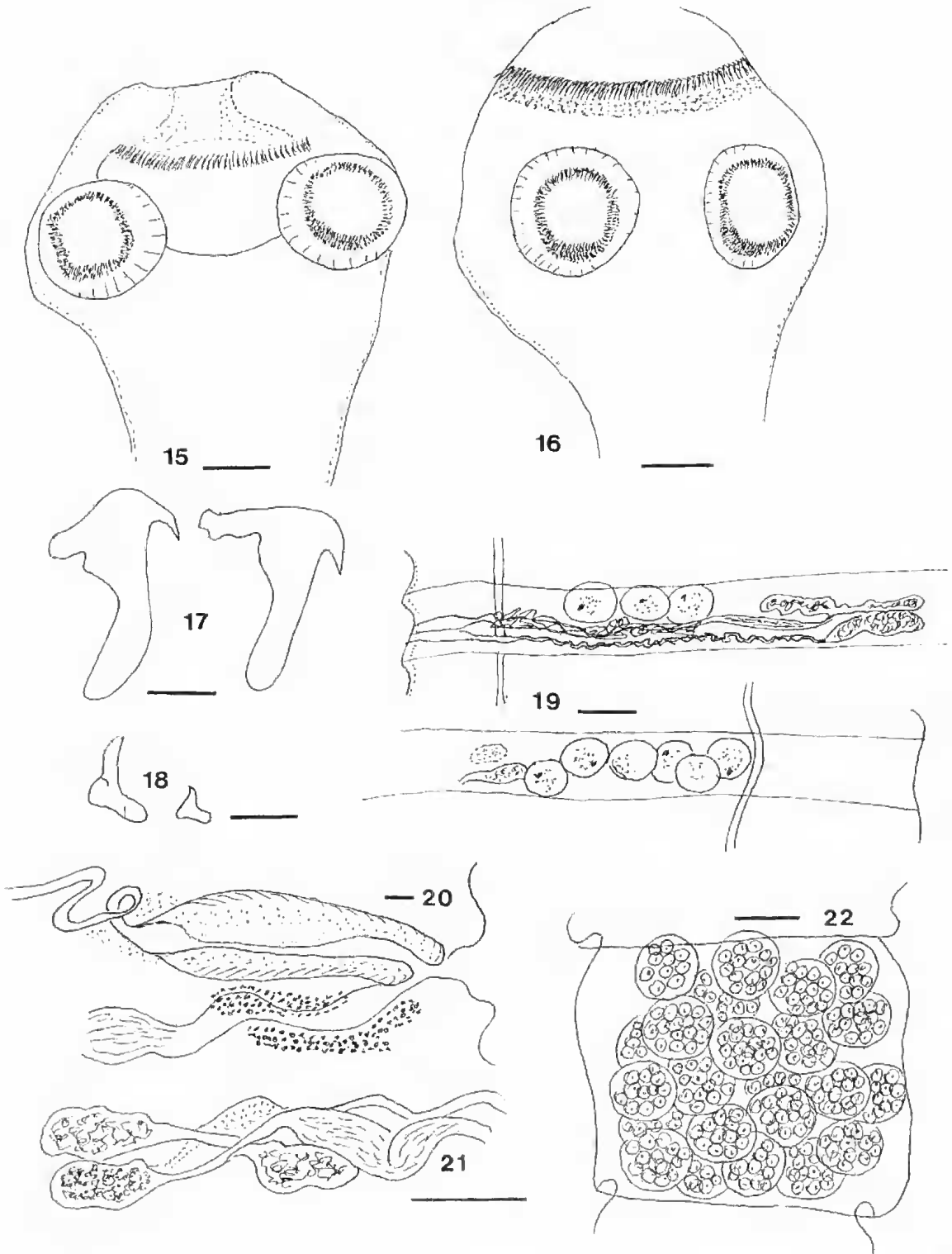
Holotype: Keith, SA, SAMA AHC S28303.

Paratypes: Kingston, SA (34°14'S, 140°21'E), Coll. M. O'Callaghan, 10.viii.1998, SAMA AHC S28304, S28305, 31379, BMNH 2000.5.17.41-60.

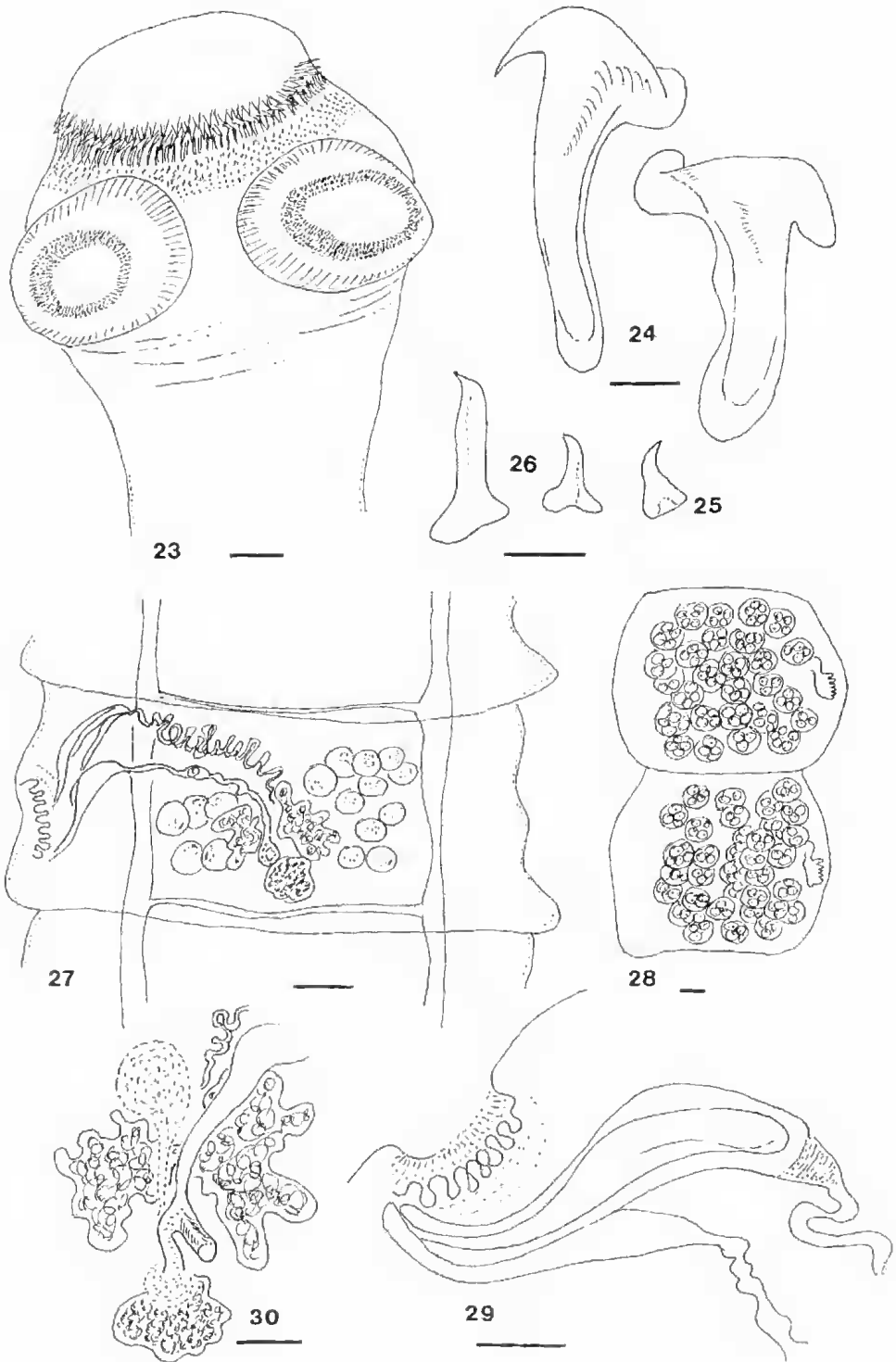
Other material examined: Wagga, NSW, 7.xii.1994, SAMA AHC 27716; Kinchega, NSW, Coll. I. Beveridge, 31.iii.1974, SAMA AHC 10005; Menindee, NSW, Coll. I. Beveridge, 10.viii.1977, SAMA AHC 11008; Pine Plains, Vic., Coll. I. Beveridge, 14.v.1971, SAMA AHC 10511; Condobolin, NSW, 27.i.1971, SAMA AHC 9179; Wagga, NSW, Coll. I. Beveridge, 7.xii.1994, Scolex only, SAMA AHC S27716.

Description

Cestode up to 45 long in unrelaxed specimens and up to 200 in relaxed specimens. Gravid strobila contain 940 proglottides. In relaxed specimens, strobila with a maximum width of 2.12. Scolex 0.480-0.752 mm (0.594, n=20) wide at suckers. Rostellum everted, 0.336-0.448 (0.397, n=20) in diameter (Fig. 23), with 124-156 (142, n=10) hammer-shaped hooks in two rows. Larger, inner rostellar hooks 0.050-0.063 (0.056, n=110) long,



Figs 15-22. *Raillietina chiltoni* sp. nov. 15. Scolex with retracted rostellum. 16. Scolex with everted rostellum. 17. Rostellar hooks. 18. Sucker hooks. 19. Single mature proglottis. 20. Cirrus and distal vagina. 21. Female genitalia. 22. Gravid proglottis. Scale bars = 0.1 mm. 15, 16, 19, 21, 22: 0.01 mm. 17, 18, 20.



Figs 23-30. *Raillietina dromaius* sp. nov. 23. Scolex. 24. Rostellar hooks. 25. Accessory rostellar spine. 26. Sucker hooks. 27. Single mature proglottis. 28. Gravid proglottides. 29. Cirrus and distal vagina. 30. Female genitalia. Scale bars = 0.1 mm. 23, 27, 28: 0.05 mm, 24-26: 0.05 mm. 29, 30.

smaller outer hooks 0.043-0.054 (0.048, $n=110$) (Fig. 24). Base of rostellum armed with 15-19 (17, $n=25$) diagonal rows of rose-thorn shaped accessory spines 0.008-0.0100 (0.009, $n=20$) long (Fig. 25). Suckers sub-circular 0.192-0.280 (0.234, $n=20$) x 0.168-0.260 (0.231, $n=20$) armed with 8-12 rows of hooklets varying in length from 0.008-0.020 (Fig. 26). Neck 0.160-0.400 long. Calcareous corpuscles present in the neck and less frequently in posterior half of scolex.

Proglottides craspedote. Mature proglottides wider than long, 0.722-1.050 (0.893, $n=10$) long x 0.205-0.370 (0.301, $n=10$) wide (Fig. 27). Gravid proglottides 0.920-0.980 x 0.740-0.790. 8-10 terminal, urn-shaped proglottides 0.500-0.730 (0.556) x 0.430-0.600 (0.472, $n=10$) (Fig. 28). Genital pores unilateral, opening into a muscular, plicate genital atrium 0.114-0.135 (0.123, $n=10$) wide x 0.041-0.082 (0.052, $n=10$) (Fig. 29), extending from the mid-point into posterior half of lateral proglottis margin. Lateral dorsal osmoregulatory canals 0.024-0.032 in diameter joined by transverse commissures in posterior region of proglottides. Ventral osmoregulatory canals not seen. Elongate cirrus sac, 0.246-0.271 (0.257) x 0.041-0.053 (0.044, $n=10$), extending anteriorly and towards but not reaching lateral osmoregulatory canal. Distal region of cirrus narrow, remainder wide, un-coiled. Vas deferens coiled, voluminous, extending transversely in anterior margin of proglottides. Testes 10-18, in poral and aporal groups, 2-6 (4, $n=15$) poral and 8-12 (10, $n=15$) aporal, 0.041-0.057 (0.048, $n=15$) x 0.040-0.050 (0.040, $n=15$), lying within lateral osmoregulatory canals.

Vagina opening to genital atrium posterior to male genital pore. Distal region of vagina enlarged, 0.040-0.050 (0.048, $n=5$) x 0.020-0.024 (0.022, $n=5$). Mid region sinuous, leading anteriorly and medially, occasionally overlying testes, into a large seminal receptacle, 0.088-0.120 x 0.028-0.040, lying anterior to poral lobe of ovary; sperm duct passes posteriorly, lined with bristles. Ovary bipartite, each lobe of approximately equal size 0.090-0.130 (0.106, $n=10$) x 0.041-0.061 (0.050, $n=10$) (Fig. 30). Vitellarium medial, post ovarian, sub-circular 0.074-0.090 (0.082) x 0.066-0.094 (0.08, $n=10$). Uterine duct passing anteriorly to developing uterus. Egg capsules 0.156 (0.136-0.190) x 0.124 (0.099-0.140), spheroidal, 12-18 (15, $n=20$) in each proglottis; containing 15-22 (17, $n=10$) eggs, 0.045-0.051 (0.049) x 0.036-0.041 (0.038, $n=5$). Oncosphere oval 0.017-0.018 (0.018, $n=5$) x 0.014-0.016 (0.015, $n=5$), embryonic hooks 0.005-0.007 long.

Host

Dromaius novaehollandiae (Latham, 1790) (Struthioniformes: Dromaidae)

Location in host

Small intestine.

Etymology

This species is named after the host, *Dromaius novaehollandiae*.

Raillietina mitchelli sp. nov.

(FIGS 31-38)

Holotype: Keith, SA (36° 06' S, 140° 19' E), SAMA AHC S28306.

Paratypes: Keith, SA SAMA AHC S28307, 31380, BMNH 2000.5.17.61-65.

Other Material examined: Yunta, SA, Coll. G. E. Ford, 1.ix.1981, SAMA AHC 11181.

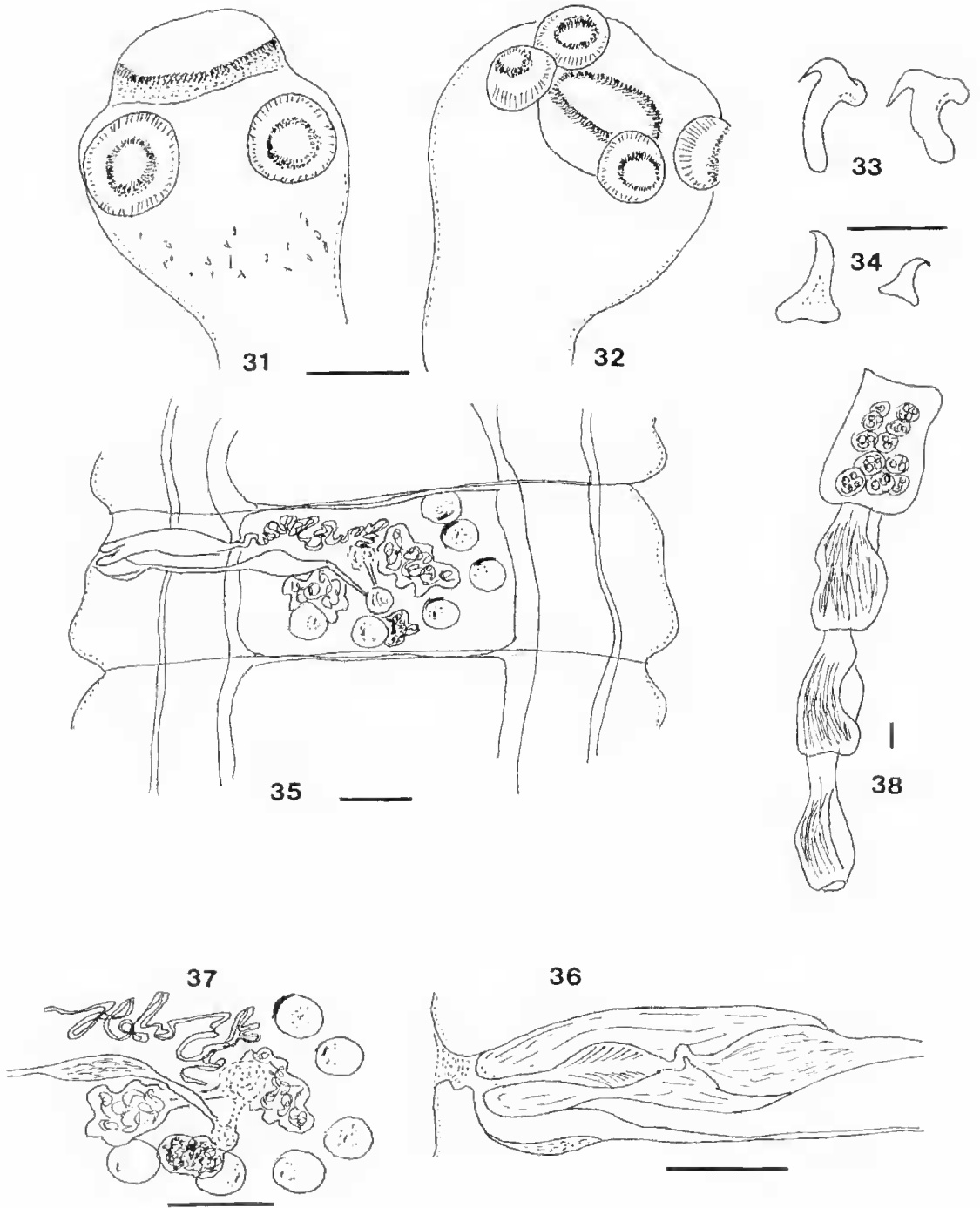
Description

Cestodes up to 120 long in relaxed specimens. Strobila containing approximately 1120 proglottides. Scolex small, 0.224-0.340 (0.298, $n=45$) in diameter (Figs 31, 32), usually with eversible rostellum, 0.108-0.154 (0.138, $n=40$) in diameter. Rostellum armed with 296-380 (316, $n=20$) hammer-shaped hooks in two rows. Larger: inner rostellar hooks 0.009-0.012 (0.011, $n=70$) long; outer, smaller rostellar hooks 0.008-0.010 (0.009, $n=70$) long (Fig. 33). Surface of everted rostellum, anterior to rostellar hooks, covered by minute accessory spines, 0.010-0.020 long, visible under high magnification only. Suckers 0.055-0.088 (0.072, $n=40$) in diameter, armed with 4-6 rows of hooks 0.004-0.010 long (Fig. 34). Neck absent.

Proglottides craspedote. Mature proglottides wider than long, 0.600-0.900 (0.822) x 0.180-0.220 (0.204, $n=10$) (Fig. 35). Genital pores, single, unilateral. Genital ducts passing between osmoregulatory canals, larger ventral osmoregulatory canal, 0.020 in max. diam., lying internal to dorsal canal, 0.012 in max. diam. Ventral canal joined by transverse osmoregulatory canal in posterior margin of proglottides. Transverse dorsal canal not seen.

Genital anlage first appearing in proglottides 400-520. Male and female genitalia mature in proglottides 640-750. First gravid proglottides 1000 with 100-120 gravid proglottides terminating with 10-20 compact proglottides becoming progressively longer than wide.

Genital atrium small, situated in anterior half of lateral proglottis margin. Cirrus sac 0.152-0.176 (0.161) x 0.032-0.044 (0.038, $n=10$) (Fig. 36) not reaching ventral osmoregulatory canal. Distal region of cirrus lined with spines, of greater internal diameter than sinuous mid region; proximal region forms spherical internal seminal vesicle 0.028-0.052



Figs 31-38. *Raillietina mitchelli* sp. nov. 31. Scolex with everted rostellum. 32. Scolex with retracted rostellum. 33. Rostellar hooks. 34. Sucker hooks. 35. Single mature proglottis. 36. Cirrus and distal vagina. 37. Female genitalia. 38. Terminal gravid proglottides. Scale bars = 0.1 mm, 31, 32, 35, 37, 38; 0.05 mm, 33, 34; 36.

(0.040) x 0.020-0.032 (0.026, n= 10). Vas deferens slightly coiled at midline of proglottis. Testes 0.048-0.060 (0.053, n=10) in diameter, dorsal to and overlying female genital glands. Testes 5-6 (5, n=20) per proglottis, one frequently overlying vitellarium with additional testes, 1 poral and 3-4 aporal.

Vagina opening to genital atrium posterior to cirrus sac. Distal region, dilated, 0.082 x 0.024-0.032, mid region, narrow, straight, leads medially posterior to vas deferens, terminating in fusiform seminal receptacle 0.124-0.152 (0.143) x 0.024-0.036 (0.028, n=10). Ovary bilobed (Fig. 37). Poral lobe 0.064-0.096 x 0.104-0.112, consisting of 1-3 transversely elongate lobules. Aporal lobe, 0.112-0.160 x 0.128-0.160 consisting of 3-4 lobules. Vitellarium irregularly ovoid, 0.056-0.076 (0.070) x 0.040-0.056 (0.049, n=10). Mehlis gland spherical, anterior to vitellarium 0.024-0.032 (0.028, n=10) in diameter. Uterine duct passing anterior to vitellarium, terminating dorsal to ovary. Uterus absent. Gravid proglottides wider than long 0.084-1.120 (0.964) x 0.272-0.360 (0.316, n=10) containing 9-15 egg capsules 0.140-0.170 (0.150) x 0.100-0.150 (0.130, n=10) each with 12-18 (15, n=10) eggs 0.041-0.049 (0.045) x 0.035-0.045 (0.040, n=10). Terminal segments shrivelled (Fig. 38). Oncosphere 0.015-0.018 (0.017) x 0.014-0.017 (0.016, n=10); oncospherical hooks 0.004-0.006 long.

Host

Dromaius novaehollandiae (Latham, 1790)
(Struthioniformes: Dromaiidae).

Location in host

Small intestine.

Etymology

This species is named for Sir Mark Mitchell in acknowledgment of support of this project through the Sir Mark Mitchell Foundation.

Comparison with other species

Of the species of *Raillietina* with hosts in the Struthioniformes, *R. dromaius* sp. nov. resembles *R. casuarii* found in the New Guinean cassowary, *Casuarinus plecticollis* in the size of the rostellar hooks (Kotlán 1923). However, *R. dromaius* is smaller than *R. casuarii*, has fewer rostellar hooks (142 v. 250), fewer and smaller testes and there are fewer eggs per capsule. *Paroniella appendiculata* Fuhrmann, 1909 described from an unknown host in New Guinea is similar in size to *R. dromaius* with 130 rostellar hooks 0.036-0.043 in length. However, *P. appendiculata* has only one egg per capsule (diagnostic for the genus *Paroniella*), a smaller cirrus sac and more testes than *R. dromaius*.

Raillietina chiltoni sp. nov. resembles *R. infrequens* (Kotlán, 1923) in the size of the strobila, scolex and rostellar hooks, the number of rostellar

TABLE 1. Key features of *Raillietina* species in emus

	<i>R. australis</i>		<i>R. beveridgei</i>		<i>R. chiltoni</i>		<i>R. dromaius</i>		<i>R. mitchelli</i>	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Size of Large Rostellar hooks	0.025	0.021-0.030	0.019	0.016-0.021	0.032	0.026-0.039	0.056	0.050-0.063	0.011	0.009-0.012
Size of small Rostellar hooks	0.020	0.016-0.023	0.016	0.014-0.019	0.027	0.022-0.034	0.048	0.043-0.054	0.009	0.008-0.010
Dimension of Cirrus sac										
Length	0.158	0.152-0.168	0.298	0.256-0.328	0.108	0.104-0.112	0.257	0.246-0.271	0.161	0.152-0.176
Width	0.020	0.013-0.024	0.080	30-44	0.038	0.036-0.040	0.044	0.041-0.053	0.038	0.032-0.044
Number of Rostellar hooks	280-362		304-412		302-378		124-156		296-380	
Dimensions of Scolex	0.416-0.568		0.480-0.736		0.545-0.832		0.480-0.752		0.224-0.340	

hooks and testes. However, *R. chiltoni* differs from *R. infrequens* in the size of the cirrus sac (0.108 x 0.038) compared with (0.180-0.200 x 0.060) in *R. infrequens*. In addition, the cirrus of *R. chiltoni* has no armature and the internal seminal vesicle is smaller (0.015 x 0.012 v. 0.054 long). *Raillietina chiltoni* has a larger rostellum (0.383) than *R. infrequens* (0.250) and has testes in distinctly aporal and poral groups that are never in the midline.

In the struthioniformes, *Cotugnia collini* can be distinguished from *Raillietina* species by the presence of two sets of bilateral genital organs.

The species of *Raillietina* described here can be distinguished from all congeners in the Struthioniformes by the size and number of the rostellar hooks, size of the scolex and size of the cirrus sac (Table 1).

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